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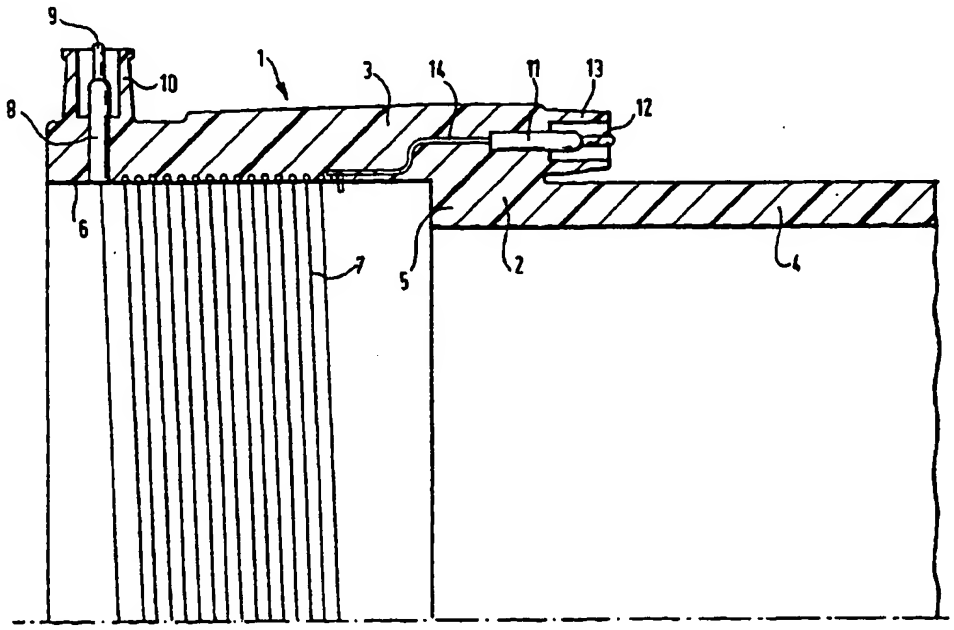

(57) Abstract

An electrofusion pipe fitting (1) comprises: a hollow thermoplastic sleeve member (2), an electrical heating element (7) disposed within the hollow sleeve member, electrical terminals (8) disposed on an outer surface of the hollow sleeve member and connected to the electrical heating element, at least one such electrical terminal being disposed in a non-radial direction (11) with respect to the hollow sleeve member. Composite electrofusion fittings are made by joining a plurality of hollow thermoplastic sleeve members, at least two of which have an electrical heating element located about the inner wall thereof, and connecting the electrical heating elements together.

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Improvements in or Relating to Pipe Fittings

FIELD OF THE INVENTION

This invention relates to pipe fittings, and more particularly to composite pipe fittings, to weldable pipe fittings and to methods for manufacturing such fittings.

BACKGROUND TO THE INVENTION

Weldable pipe fittings generally comprise hollow thermoplastic fittings for connection to thermoplastic pipes or like members in which a portion of an inner peripheral wall of the fitting is arranged to be joined by fusion or "welding" to a portion of an outer peripheral wall of a pipe or like member. Electrofusion pipe fittings, with which the invention is particularly concerned, are those in which the fusion or "welding" is accomplished by means of an electrical heating element which is located at or adjacent to the boundary between the inner wall of the fitting and the outer wall of the pipe or like member.

Electrofusion pipe fittings usually comprise a hollow thermoplastic sleeve member, having an electrical heating element located about the inner wall thereof, so that when in use the fitting is placed in mating contact about a thermoplastic pipe or like member, and current is passed through the electrical heating element, the adjacent mating surfaces of the fitting and the pipe or like member melt, and fusion or "welding" of the surfaces takes place.

Examples of electrofusion pipe fittings are described in UK Patent No. 1440713, and US Patent Nos. 3062940 and 3094452, the disclosures of which are incorporated herein by reference.

The vast majority of available electrofusion pipe fittings are in-line couplers, due to the present difficulty of manufacturing more complicated shapes such as reducers, tees and bends. This substantially limits the field of use of electrofusion pipe fittings.

Connectorising the ends of the electrical heating element of the pipe fitting has also proved a problem. The connection cannot normally be brought out through a stress region in the pressure containing area of the sleeve member since this may give rise to undesirable cracks or leaks during installation (fusion) or in service. A common solution is to provide raised electrical terminals on the outer peripheral surface of the sleeve member, in an area outside the pressure containing part of the structure, the terminals being surrounded by upstanding protective boss members. Examples of such connectorised electrofusion pipe fittings are described in UK Patents Nos. 2135746, 2135747, and European Patents Nos. 0260014, 0243062, 0353912 and 0189918, the disclosures of which are incorporated herein by reference.

Connectorised electrofusion pipe fittings of this type have been very successful in practice, but do have certain drawbacks. Firstly, they require to be injection moulded

using very large injection moulding machines having very high clamping pressures. This is because the presence of the raised electrical terminals and the upstanding boss members necessitates the use of a longitudinally split mould and radial injection of the thermoplastic material. In addition, it is very difficult to make more complicated fittings such as reducers, tees and bends by this method.

Another solution to the problem is to use a bifilar or bridged conductor as the heating element in the fitting, but this vastly increases the possibility of an electrical short in the heating element during the fusion process.

European patent application no. 0521276, the disclosure of which is incorporated herein by reference, describes a reducing fitting for joining pipes with different diameters which has a wider part which can be butt-welded to the larger pipe and a narrower part having a resistance heater winding for welding to the smaller pipe. This fitting uses a bifilar heating element, and the disclosure does not address any of the problems outlined above.

In European Patent Application No. 0535247, there is described a pipe joint member for use in connecting the ends of synthetic resin pipes, which consists of one or more cylindrical socket members provided at one end with a fusion welding portion into which an end of a resin pipe is fitted and in which a heating coil is embedded, and with a connecting portion at the other end, and a piping component part having at least one opening, wherein the socket member

is connected to an appropriate opening of the piping component part through the connecting portion. The pipe joint members disclosed in EPA 0535247 use raised electrical terminals, and the heating coils have to be separately energised, leading to complications both in manufacture and installation.

SUMMARY OF THE INVENTION

The present invention provides various novel composite electrofusion pipe fittings formed by fusion or welding of sleeve members containing electric heating elements.

The invention further provides a novel electrofusion pipe fitting that is so shaped that it can be removed from the mould by relative axial movement, and a novel injection moulding process for the production of weldable pipe fittings.

The invention also provides a novel connectorised electrofusion pipe fitting in which the terminals are located in areas outside the pressure containing part of the structure without the use of two raised electrical terminals and which can avoid the use of a bifilar heating element.

According to a first aspect of the invention there is provided a composite electrofusion pipe fitting which comprises

a plurality of hollow thermoplastic sleeve members,

at least two of the sleeve members each having an electrical heating element located about the inner wall

thereof, the two said electrical heating elements being electrically connected together,

and the sleeve members being joined to each other so as to leave those members provided with electrical heating elements available to receive pipes therein to be joined thereto by electrofusion.

The composite electrofusion pipe fitting can comprise, for example a junction, a tee, a bend, a reducer, or similar construction which would present problems for, or be expensive to produce by, injection moulding. Preferably each of the hollow thermoplastic sleeve members has an end region which can be joined to another sleeve member by melt fusion, and particularly butt fusion, to form a more complex structure. Although such butt fusion can be practised on site, it is more commonly carried out in the factory. Typically the hollow thermoplastic sleeve members themselves can be pipe couplers or reducing fittings or similar components.

According to a second aspect of the invention there is provided an electrofusion pipe fitting which comprises,

a hollow thermoplastic sleeve member,

an electrical heating element disposed within the hollow sleeve member,

electrical terminals disposed on an outer surface of the hollow sleeve member and connected to the electrical heating element,

at least one such electrical terminal being disposed so as to lie in a substantially longitudinal direction with respect to the hollow sleeve member.

In a further aspect of the invention, the electrical terminal which is disposed so as to lie in a substantially longitudinal direction with respect to the hollow sleeve member is located in a region which is outside the pressure containing region of the electrofusion pipe fitting.

In another aspect the invention provides a method of moulding a weldable pipe fitting which comprises,

injecting molten thermoplastic polymeric material into a mould cavity defining a hollow sleeve member and formed by a hollow outer mould and a mould core,

allowing the thermoplastic polymeric material to solidify, and removing the moulded hollow sleeve member from the hollow outer mould by relative axial movement there between. Preferably the molten thermoplastic polymeric material is injected into the mould cavity in a longitudinal direction, rather than in a radial direction as has been practised hitherto. Longitudinal injection can be carried out using lower clamping pressures and can avoid the need to use a split outer mould.

DETAILED DESCRIPTION OF THE INVENTION

The electrofusion pipe fittings of the invention comprise one or more hollow sleeve members which may be formed from any suitable thermoplastic polymeric material, for example an olefinically unsaturated polymeric material

such as polyethylene, polypropylene, polybutylene, and higher olefinic polymers; copolymers of ethylene, propylene and butylene with each other and with other olefinically unsaturated monomers; olefinically unsaturated aromatic polymers such as polystyrene and styrene copolymers; and polymers and copolymers of vinyl monomers such as ethylene-vinyl acetate copolymers, polycarbonates, and such like materials.

The or each hollow sleeve member may be of constant diameter throughout its length, but preferably comprises at least two regions of different diameter separated by a "step" region. In a preferred embodiment, the electrical heating element is disposed substantially entirely within the region of larger diameter, and the region of smaller diameter is therefore available to be connected, for example by melt fusion, and particularly by butt fusion, to another hollow member.

The electrical heating element preferably comprises a coil of resistance wire which is preferably disposed on or adjacent to an inner surface of the hollow sleeve member, and for example in a preferred construction, the electrical heating element is embedded in the wall of the hollow sleeve member adjacent the said inner surface. In an alternative construction, the electrical heating element may be a coil of resistance wire disposed in a helical groove machined on the inner surface of the hollow sleeve member. The resistance or impedance of the electrical heating element is such that, when powered by a direct or

alternating current, the element will heat up causing local fusion of the inner surface of the hollow member, and in some cases local fusion of the outer surface of the pipe, so as to fuse the sleeve member to the pipe.

The electrical element is normally provided with two electrical terminals for connection to a suitable power source such as a generator. More than two such terminals may of course be provided if necessary. The terminals may be of any suitable type for the attachment of power cables or the like, and may have screw-on or push-on fittings as appropriate. The terminals are disposed on an outer surface of the hollow sleeve member and the connections to the electrical heating element are made through the thickness of the sleeve member.

At least one of the electrical terminals is disposed so as to lie in a substantially longitudinal direction with respect to the hollow sleeve member. This can conveniently be accomplished by arranging for the longitudinally-disposed electrical terminal to be positioned at a "step" region of the hollow sleeve member, where there is a change in diameter of the sleeve member. This enables a bus bar from the electrical heating element to extend substantially longitudinally from the larger diameter region of the sleeve member, having the electrical heating element disposed therein, through the wall of the sleeve member, to the longitudinally-disposed electrical terminal situated at an outer surface of the sleeve member in the smaller

diameter region thereof. This preferred construction has a number of significant advantages as follows:

1. The distance across the wall between the electrical heating element and the electrical terminal can be increased, thereby reducing the stress concentration at the terminal exit point, without increasing the overall thickness of the sleeve member. The electrical terminal is thus located in a low stress area away from the pressure containing region of the electrofusion fitting.

2. The configuration of the sleeve member is such that the sleeve member can be axially removed from an injection mould.

3. The longitudinally-disposed electrical terminal is easy to connect to a similar terminal in a tee, bend, or the like, in a multi-part construction.

Preferably one or both of the terminals are positioned such that at least a portion of the terminal lies outside the wall of the sleeve member, that is, the terminal lies proud of the surface of the sleeve member. If the terminal is positioned wholly within the wall of the sleeve member, this requires a recess to be formed in the wall to accommodate a connector for the electric power source, which recess can be a point of weakness for the fitting leading to burst through of molten plastic, or to splitting of the sleeve.

Each of the terminals are preferably surrounded by a protective boss member, which may cooperate with the connector from the electric power source to form a coupling

which firmly connects a lead from the power source to the terminal.

In the method of the invention, a weldable pipe fitting is produced by injection moulding and axial withdrawal of the product from the mould. The prior art fittings could not be made in this way due to the presence of recesses, or boss members, around the terminals, which necessitated the use of a split mould. In the present invention the weldable pipe fitting is configured in such a fashion that axial withdrawal is possible, preferably by the provision of at least one electrical terminal disposed so as to lie in a substantially longitudinal direction with respect to the pipe fitting. It is possible to have one of the terminals of the weldable pipe fitting which does not lie longitudinally or axially of the pipe fitting, but in such a case it is preferable for this terminal to be situated at an end of the fitting so that axial withdrawal of the moulded fitting can still be easily accomplished by withdrawing that end first, and so that the terminal is not situated in an area of the sleeve subject to high stress. The hollow sleeve member of the weldable pipe fitting is formed in a mould cavity comprising a hollow outer mould and a mould core. The outer mould may have recesses defining boss members for the terminals of the fitting, so as to permit longitudinal or axial withdrawal of the moulded fitting. The mould core may have means for winding the coil of the electrical heating element therein, or it may provide support for a metal former upon which the coil

is wound before placement in the mould. In a still further possibility, the coil of the electrical heating element may be wound on a former and then embedded in a layer of thermoplastic material in a first moulding step. The embedded coil can then be removed from the former and placed in the mould for the final moulding step. Whichever route is taken, it will be apparent that it is necessary to connect the terminals to the electrical heating element before it is placed in the mould.

After axial injection of the molten thermoplastic material into the mould, and solidification thereof, the pipe fitting is ejected axially from the outer mould, starting at the end with the upstanding boss member, if present, by relative axial movement of the outer mould and the mould core. The pipe fitting can be separated from the outer mould and the mould core at the same time, or sequentially as desired. Any metal former present is usually separated from the fitting in a further operation.

As previously stated, two or more electrofusion pipe fittings according to the invention may be connected to form a composite fitting, which may be a junction, a coupler, a tee, a bend, or a similar fitting. The composite fitting can be formed by connection of one or more electrofusion pipe fittings according to the invention to a further component which may be, for example, a pipe or a bend without an electric heating element, or another such electrofusion fitting. Such composite fittings, formed, for example, by melt fusion of an electrofusion pipe

fitting to a further component with or without an electric heating element can be made significantly more cheaply than hitherto.

Where two or more electrofusion pipe fittings of the invention are combined in a composite electrofusion fitting, it is a simple matter to link the electrical heating elements by means of the longitudinally-disposed electrical terminals using, for example, a conductive bus bar which may, if desired be plastic covered. The bus bar can, for example, comprise a metal rod which can also act as a carrying handle, or which can have a carrying handle attached thereto. Such electrical connection enables two or more electrical heating elements to be energised simultaneously, greatly simplifying installation procedures.

In a further embodiment of the invention, the electrofusion pipe fitting can be converted into a fitting having two upstanding electrical terminals by the use of an elbow adaptor terminal which plugs into the longitudinally-disposed electrical terminal of the fitting.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of electrofusion pipe fittings and an injection moulding method according to the invention will now be described with reference to, and as illustrated in the accompanying Drawings in which:

Figure 1 shows a sectional side elevation of the upper half of a first embodiment of an electrofusion pipe fitting according to the invention;

Figure 2 shows a sectional side elevation of the upper half of an injection mould for carrying out the method of the invention;

Figure 3 shows a top elevational view of a second flanged embodiment of an electrofusion pipe fitting according to the invention;

Figure 4 shows a top elevational view of a third bell-ended embodiment of an electrofusion pipe fitting according to the invention;

Figures 5, 6 and 7 show top elevational views of bends comprising composite fittings according to the invention;

Figures 8 and 9 show top elevational views of tees comprising composite fittings according to the invention;

Figure 10 shows a broken side elevation of an electrofusion pipe coupler according to the invention having a handle attached to the bus bar; and

Figure 11 shows a sectional side elevation of the top half of an electrofusion pipe fitting according to the invention provided with an elbow adaptor terminal.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

Referring now to Figure 1, the electrofusion pipe fitting 1, comprises a hollow cylindrical body member 2, having a large diameter portion 3 and a smaller diameter portion 4 separated by a step region 5. Within the inner

wall 6 of the large diameter portion 5 there is embedded a heating element 7, comprising a plurality of turns of resistance wire. A first electrical terminal 8 is situated adjacent the end of the body member 2 and is connected to a first end of the heating element 7. The electrical terminal 8 extends through the wall of the body member 2 and protrudes above the outer surface thereof. The upper portion 9 of the electrical terminal is adapted to receive a connector from a power source (not shown) and is surrounded by an upstanding protective cylindrical boss member 10.

A second electrical terminal 11 extends in a longitudinal direction with respect to the axis of the cylindrical body member 2, from the step region 5 and over the smaller diameter portion 4 of the body member. The extending portion 12 of the second electrical terminal 11 is adapted to receive a connector from a power source (not shown) and is surrounded by a longitudinally-extending protective cylindrical boss member 13. The second electrical terminal 11 is connected to a second end of the heating element 7 via a bus bar 14 which passes through the shoulder region 5 of the body member.

The electrofusion pipe fitting 1 can be used as a pipe coupler or as a reducing fitting. When used as a pipe coupler, two such fittings are joined together, either directly or via a short length of pipe, by butt fusion of the smaller diameter portions 4. When used as a reducing fitting, the smaller diameter portion 4 is butt fused to

the smaller of the pipes to be joined. In both cases, the heating elements are available for electrofusion to a larger diameter pipe inserted into the larger diameter portion 3 of the fitting.

A weldable pipe fitting can be made using an injection mould as illustrated in Figure 2. The mould 20 has a movable portion 21 and a fixed portion 22 which together define a cylindrical mould cavity 23 having the stepped configuration as described in connection with Figure 1. The mould core 24 is connected to the fixed portion 22 of the mould, and is dimensioned, at its larger diameter portion 25, to receive a cylindrical metal former 26. The former 26 carries the heating element 27 together with its associated terminals 28 and 29. The longitudinally-disposed terminal 29 carries an "O" ring 30 to seal any leak path that may arise along the terminal. By positioning this "O" ring seal remote from the heating element 27, it is not subject to the localised pressures and distorting stresses associated with the heating of the region adjacent to the heating element in the fusion process. The radially-disposed terminal 28 is surrounded by a side action plunger 31 (shown in side elevation) which forms the wall of its surrounding boss member in the finished moulding.

In operation, molten thermoplastic material is injected axially into the mould cavity 23 in the direction indicated by the arrow A until the desired shot weight has been achieved. Moulding in the axial direction can replace

the clamp pressure required by a factor of 2. After injection has been completed and the thermoplastic has solidified, the mould is opened by sliding the moving portion 21 in an axial direction as indicated by arrow B. It will be appreciated that because the terminal 29 is axially aligned, there is no impediment to this axial movement. The side action plunger 31 is then raised and the moulded fitting can be removed from the mould core 24 together with the metal former 26. The metal former is finally manually removed from the completed mould fitting.

Figure 3 shows a top view of a flanged stepped fitting 40 according to the invention, having at the end of its smaller diameter region 41, a flange 42, adapted to be connected to a similar flange of a pipe or tube. Terminals 43 and 44 are respectively longitudinally and radially disposed.

Figure 4 shows a bell-ended fitting 50 according to the invention, again having terminals 51 and 52, respectively longitudinally and radially disposed.

Figures 5, 6 and 7 show various couplers formed using two electrofusion fittings according to the invention joined by pipe bends. In each case the couplers 60, 60a and 60b are formed from fittings 61, 62, 61a, 62a, 61b, 62b, which have been butt fused to pipe bends 63, 63a, 63b. Bus bars 64, 64a and 64b extend between longitudinally-disposed terminals 65, 66, 65a, 66a, 65b, 66b respectively so that the heating elements in the two electrofusion fittings can be powered simultaneously by connecting a

power source to terminals 67, 68, 67a, 68a and 67b, 68b respectively.

Figures 8 and 9 show the use of the invention to produce tee couplers using three electrofusion fittings. In Figure 9 the in-line fittings 70, 71 have their longitudinally-disposed terminals 72, 73 connected by a bus-bar 74 for simultaneous powering.

Figure 10 shows the use of the bus-bar connecting rod between the longitudinally-disposed terminals to form a carrying handle. The illustrated coupler 80 comprises two electrofusion fittings 81 and 82 butt fused to a short length of pipe 83. Their longitudinally-disposed terminals 84, 85 are connected by a bus bar 86, which comprises a plastic-covered metal rod. The bus bar, which is rotatable about its axis, has attached thereto a handle 87. By rotation of the bus bar, the handle can lay flat against the coupler until required.

Figure 11 shows an electrofusion fitting 90 similar to that of Figure 1, except that the longitudinally-disposed terminal 91 is positioned in a recessed socket 92. An elbow adaptor terminal 93 has a connector 94 at one end, which can be inserted in the socket 92 to make an electrical connection to the terminal 91. The elbow adaptor is retained in the socket by the cooperating lug 95 and recess 96 on the fitting and elbow adaptor respectively. At the end of the elbow adaptor remote from the connector 94 is an upstanding radially-disposed terminal 97 surrounded by a cylindrical boss member 98.

The elbow adaptor thus converts the electrofusion fitting into a standard configuration with two upstanding radially directed terminals.

The reader's attention is directed to all papers and documents which are filed concurrently with this specification and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps or any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

CLAIMS

1. A composite electrofusion pipe fitting which comprises

a plurality of hollow thermoplastic sleeve members, at least two of the sleeve members each having an electrical heating element located about the inner wall thereof, the said electrical heating elements being electrically connected together,

and the sleeve members being joined to each other so as to leave those sleeve members provided with electric heating elements available to receive pipes therein to be joined thereto by electrofusion.

2. A composite electrofusion pipe fitting according to Claim 1, which comprises a junction, a tee, a bend, a reducer, or a coupler.

3. A composite electrofusion pipe fitting according to Claim 1 or 2, in which the sleeve members are joined by melt fusion.

4. A composite electrofusion pipe fitting according to any of the preceding claims, in which sleeve members provided with electrical heating elements are joined to one or more sleeve members without electric heating elements.

5. A composite electrofusion pipe fitting according to any of the preceding claims, in which the electrical heating elements are linked by a conductive bus bar.

6. A composite electrofusion pipe fitting according to Claim 5, in which the bus bar also acts as a carrying handle, or has a carrying handle attached thereto.

7. An electrofusion pipe fitting which comprises:

a hollow thermoplastic sleeve member,

an electrical heating element disposed within the hollow sleeve member,

electrical terminals disposed on an outer surface of the hollow sleeve member and connected to the electrical heating element, at least one such electrical terminal being disposed so as to lie in a substantially longitudinal direction with respect to the hollow sleeve member.

8. A pipe fitting according to Claim 7, in which the fitting comprises a pipe coupler or a reducing fitting.

9. A pipe fitting according to Claim 7 or 8, which is adapted to be connected to another hollow member other than by electrofusion.

10. A pipe fitting to Claim 9, in which the connection is by melt fusion.

11. A pipe fitting to any of Claims 7 to 10, which comprises a hollow sleeve member formed from an olefinically unsaturated polymeric material.

12. A pipe fitting according to Claim 11, in which the olefinically unsaturated polymeric material is polyethylene.

13. A pipe fitting according to any of Claims 7 to 12, in which the hollow sleeve member comprises at least two regions of different diameter separated by a "step" region.

14. A pipe fitting according to Claim 13, in which the electrical heating element is disposed substantially entirely within the region of larger diameter.

15. A pipe fitting according to Claim 14, in which the region of smaller diameter is adapted to be connected to another hollow member by melt fusion.

16. A pipe fitting according to any of Claims 7 to 15, in which the electrical heating element is embedded in the wall of the hollow sleeve member adjacent the inner surface thereof.

17. A pipe fitting according to any of Claims 7 to 16, in which the longitudinally-disposed electrical terminal is positioned at a region of the hollow sleeve member where a change in diameter of the sleeve member occurs.

18. A pipe fitting according to any of Claims 7 to 17, in which the longitudinally disposed electrical terminal is provided with a seal located at a region of the hollow sleeve member which is outside the pressure containing region of the pipe fitting.

19. A pipe fitting according to Claim 17 or 18, in which a bus-bar from the electrical heating element extends substantially longitudinally from the larger diameter region of the sleeve member, through the wall of the

sleeve member to the longitudinally-disposed electrical terminal situated at the outer surface of the sleeve member.

20. A pipe fitting according to any of Claims 7 to, 19, in which one or both of the terminals are positioned such that a portion of the terminal lies outside of the wall of the sleeve member.

21. A pipe fitting according to any of Claims 7 to 20, in which each of the terminals is surrounded by a protective boss member.

22. A pipe fitting according to any of Claims 7 to 21, in which the pipe fitting has an upstanding radially directed terminal situated adjacent an end thereof.

23. A pipe fitting according to any of Claims 7 to 22, substantially as described and illustrated in the accompanying Drawings.

24. A pipe fitting according to any of Claims 7 to 23, substantially as hereinbefore described.

25. A method of making a weldable pipe fitting which comprises,

injecting molten thermoplastic polymeric material into a mould cavity defining a hollow sleeve member and formed by a hollow outer mould and a mould core,

allowing the thermoplastic polymeric material to solidify,

and removing the moulded hollow sleeve member from the hollow outer mould by relative axial movement therebetween.

26. A method to according to Claim 25, in which the molten thermoplastic material is injected into the mould cavity in a longitudinal direction.

27. A method according to Claim 25 or 26, in which the weldable pipe fitting has at least one electrical terminal disposed so as to lie in a substantially longitudinal direction with respect to the pipe fitting.

28. A method according to any of Claims 25 to 27, in which the weldable pipe fitting has an upstanding radially directed terminal situated adjacent an end of the fitting and withdrawal of the moulded fitting is accomplished by withdrawing that said end first.

29. A method according to any of Claims 25 to 28, in which the outer mould has recesses defining boss members for the terminals of the fitting, at least one of which recesses is longitudinally or axially inclined with respect to the moulded pipe fitting so as to permit longitudinal or axial withdrawal of the moulded pipe fitting from the mould.

30. A method according to any of Claims 25 to 29, in which the electrical heating element is supported upon a metal former before placement in the mould.

31. A method according to any of Claims 25 to 30, in which the mould is opened by relative axial movement between hollow outer mould and the mould core.

32. A method according to any of Claims 25 to 31, substantially as hereinbefore described.

33. A pipe fitting according to any of Claims 7 to 24 that has been made using a method according to any of Claims 25 to 32.

34. A composite pipe fitting which has been formed by connection of one or more electrofusion pipe fittings according to any of Claims 7 to 24 and 33 to a further component.

35. A composite pipe fitting according to Claim 34, in which the connection is by melt fusion.

36. A composite pipe fitting according to Claim 34 or 35, in which the further component is a pipe, a bend, or another electrofusion fitting.

37. A composite pipe fitting according to any of Claims 34 to 36, in which the longitudinally-disposed electrical terminals of the electrofusion pipe fittings are linked.

38. An electrofusion pipe fitting according to any of Claims 7 to 24 and 33, in which the electrofusion pipe fitting is provided with an elbow adaptor terminal which can plug into the longitudinally-disposed electrical terminal so as to convert the electrofusion pipe fitting into a fitting having two upstanding electrical terminals.

39. A composite pipe fitting according to any of Claims 1 to 6 and 34 to 37 substantially as hereinbefore

described and illustrated in the accompanying Drawings.

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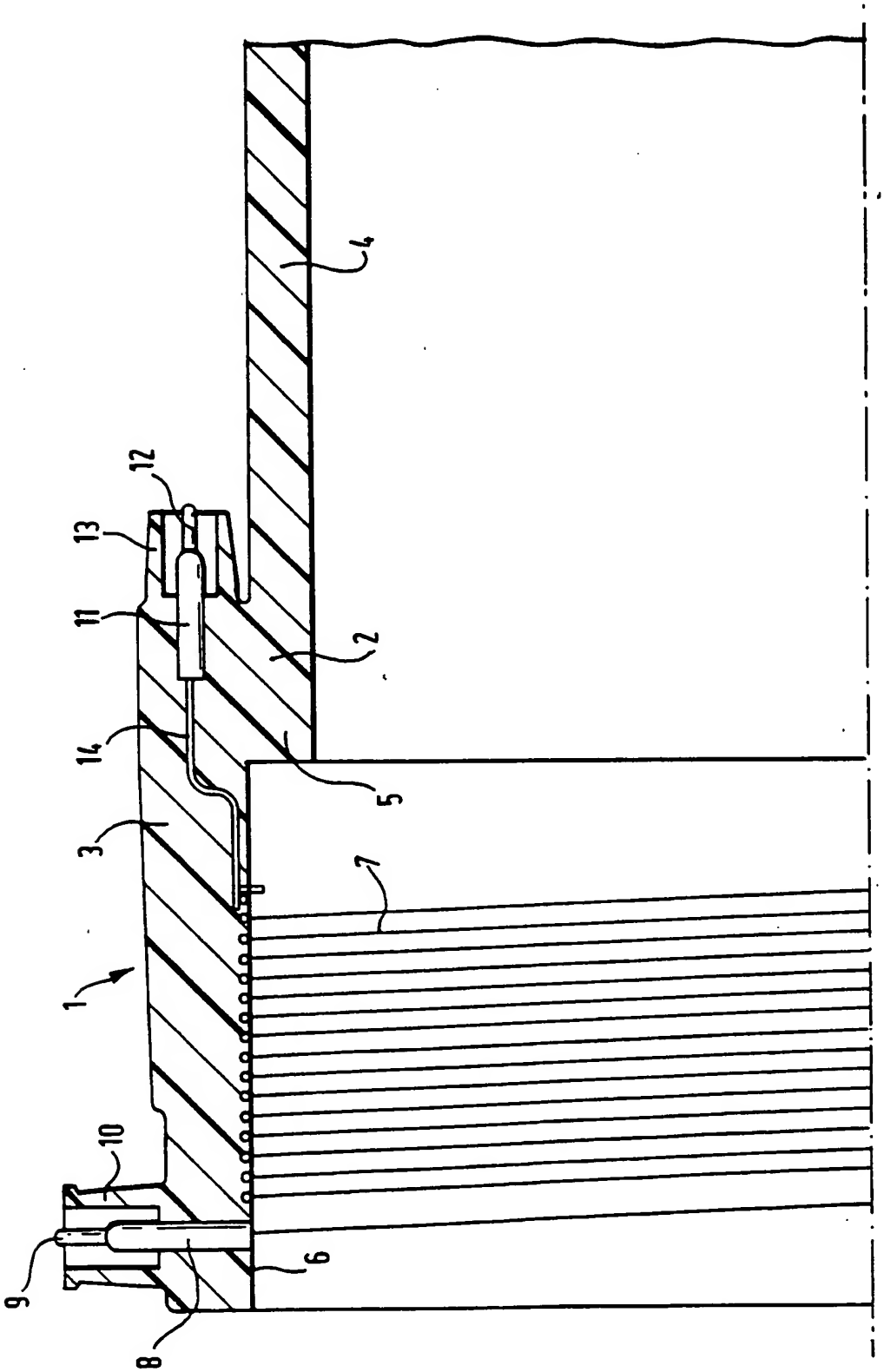


Fig.1.

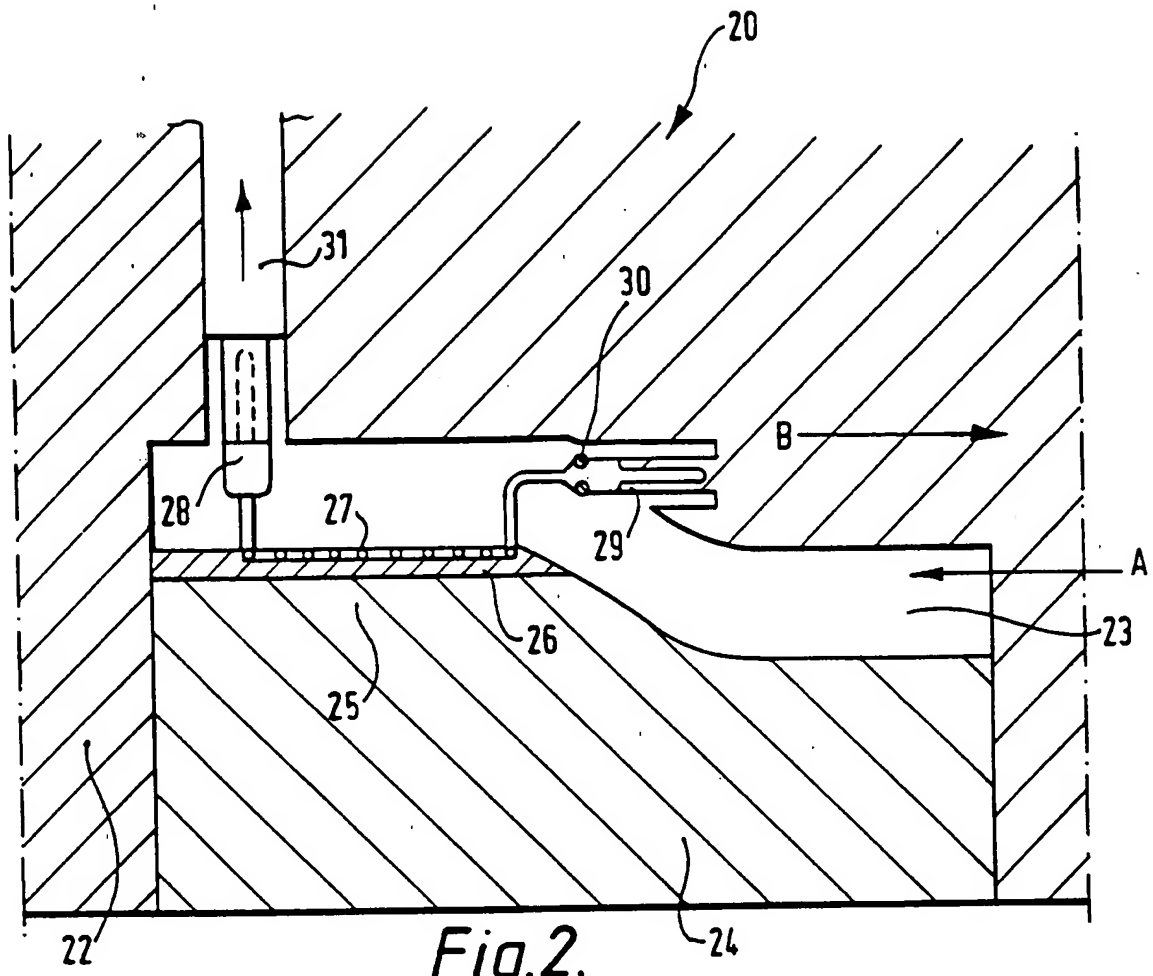
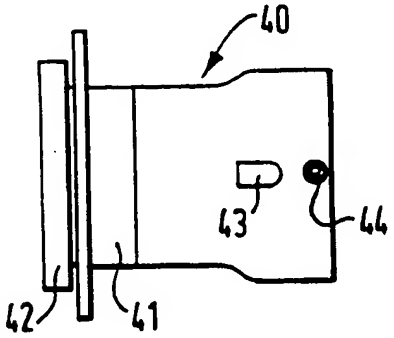


Fig.2.



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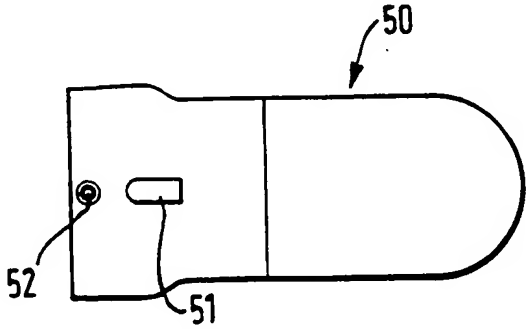
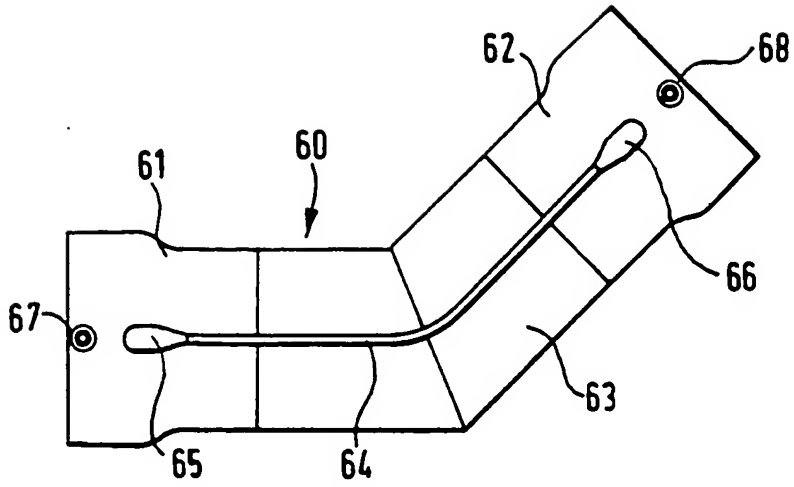


Fig.4.



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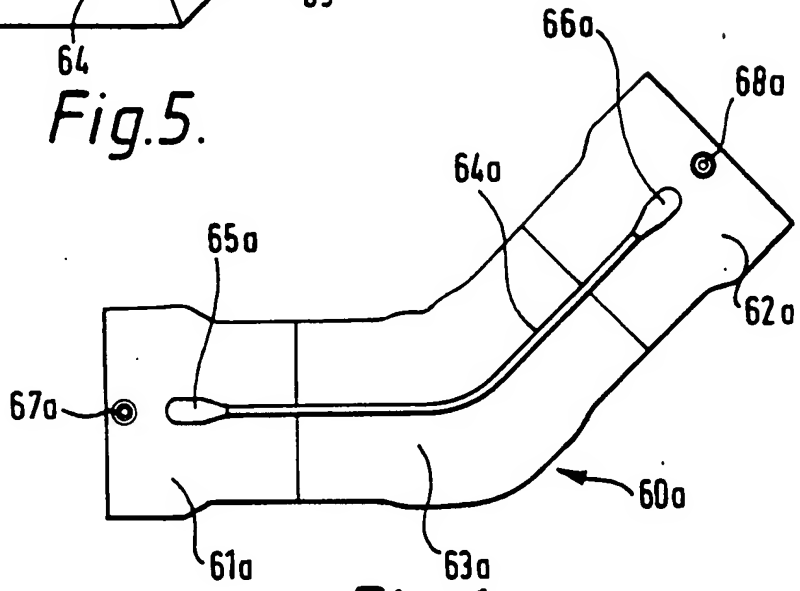

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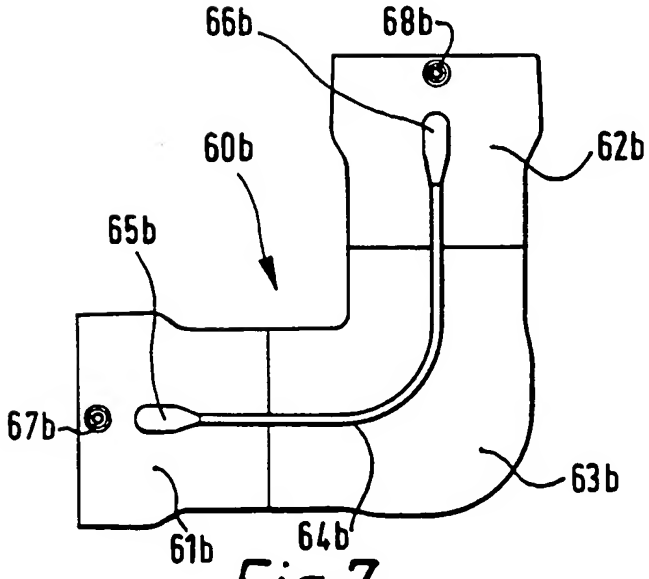

Fig.7.

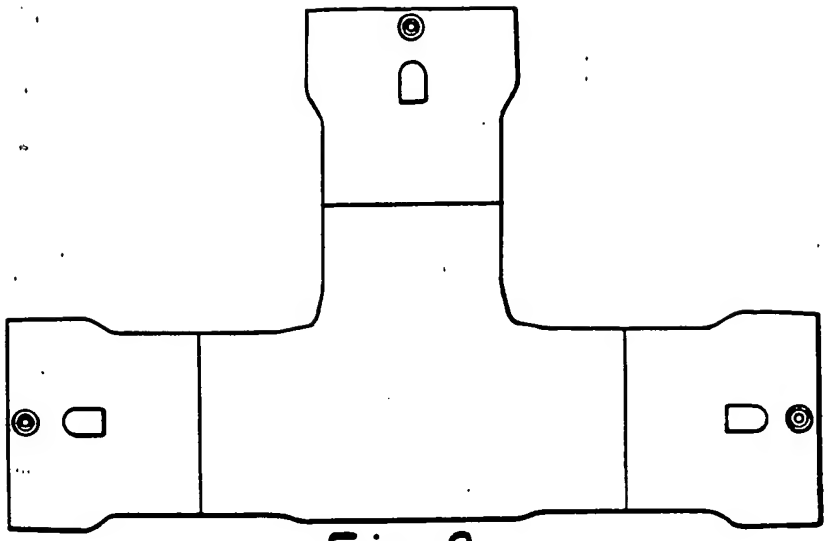

Fig.8.

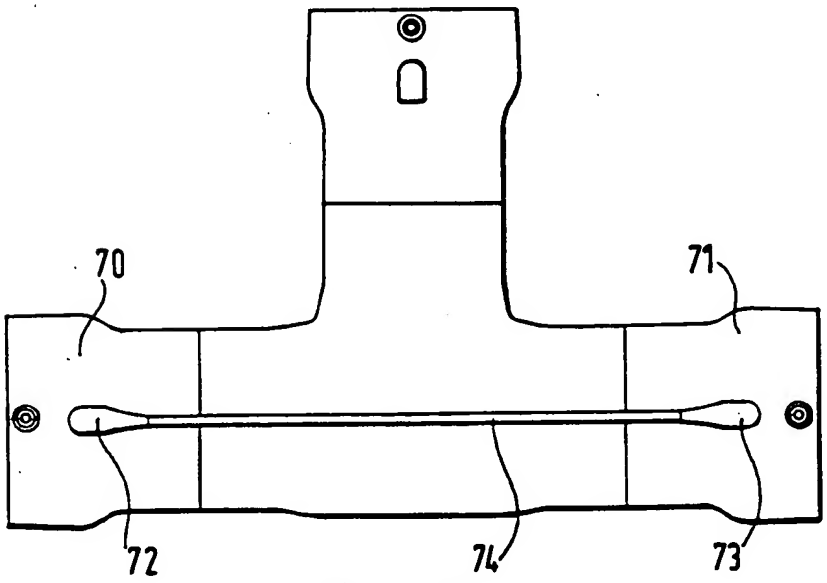

Fig.9.

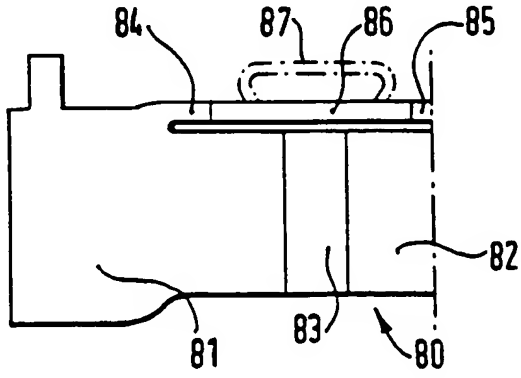

Fig.10.

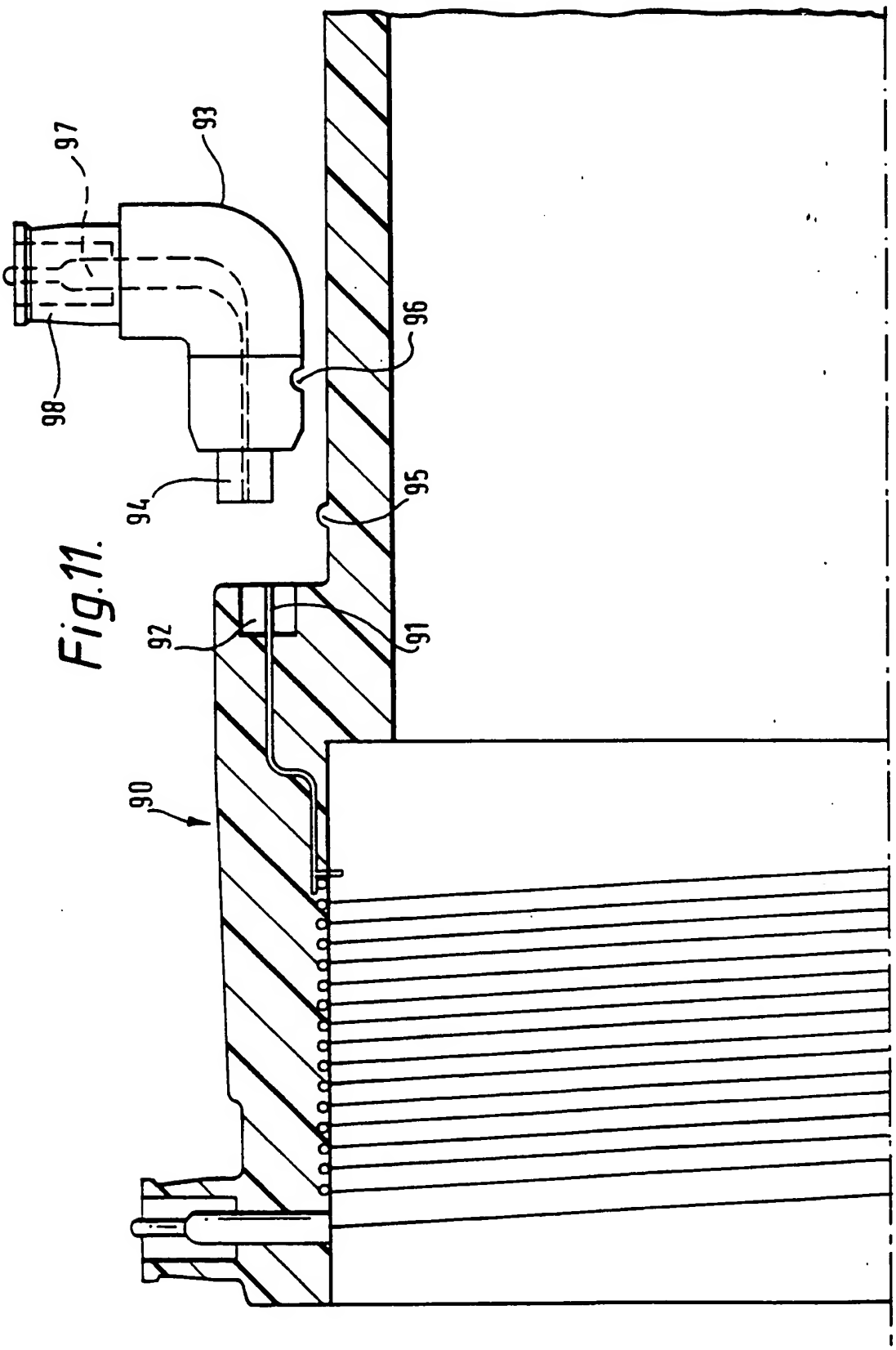

Fig.11.

INTERNATIONAL SEARCH REPORT

Internat Application No
PCT/EP 94/02973

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L47/02 B29C45/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	US,A,5 277 456 (MER ET AL.) 11 January 1994 see the whole document	1-4
A		7-16, 20-24, 34-36, 38,39

X	FR,A,1 170 720 (SUD-WEST CHEMIE GMBH) 16 January 1959 cited in the application see page 1, column 2, line 11 - line 38; figures 1-3	1-3, 7-12,16, 17,19,20
A		4,13-15, 23-27, 30-36,39

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 December 1994	23. 12. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	ANGIUS, P

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	GB,A,2 272 663 (KUBOTA CORPORATION) 25 May 1994 see abstract; claims 1-10; figures 1-18	1-4
A	---	
X	EP,A,0 260 014 (DU PONT(UK) LTD) 16 March 1988 cited in the application see the whole document	1-3,25, 31-33
A		7-12,16, 20-24, 28-30, 34-36,39

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Internat Application No
PCT/EP 94/02973

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DE-C-3411179	16-01-86	NONE		